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Adaptation of the Verb Network Strengthening Treatment (VNeST) Protocol to Persian: A Case Report

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Original Article

Abstract

Introduction: Despite the high prevalence of verb and noun retrieval impairment in aphasia, no standardized, culturally and linguistically adapted treatment program for this impairment exists for Persian-speaking individuals with aphasia in Iran. There is therefore a clear need for Verb Network Strengthening Treatment (VNeST), which aims to increase sentence production and promote the generalization of naming to untrained items. Accordingly, the present study aimed to adapt this method for use in the Persian language, to establish the content validity of its implementation, and to determine its effectiveness in a Persian-speaking individual with aphasia.

Materials and Methods: Following the adaptation of the VNeST protocol to Persian, 110 transitive verbs were selected from the Valency Dictionary of Persian Verbs, and their validity was evaluated by a panel of experts. For 102 verbs, all possible agents and patients were compiled, and the corresponding scenarios were developed. For each scenario, both minimal and maximal cues were provided. Subsequently, the Persian VNeST protocol was administered to one Persian-speaking individual with aphasia.

Results: The findings of the first phase indicate that the selected verbs and the developed scenarios possess adequate content validity. In the second phase, VNeST led to improvement in the participant's naming performance. The between-phase treatment analysis, using the percentage of non-overlapping data (PND) derived from naming assessments conducted before, during, and after treatment, yielded 90%, confirming the treatment's effectiveness for this individual with aphasia.

Conclusion: The results of this study demonstrate that VNeST can also be applied in the Persian language and that its implementation procedure possesses adequate content validity. Furthermore, the degree of improvement in the naming deficits of the individual with aphasia under this method was acceptable, indicating its effectiveness.

Keywords: Aphasia; Verb network strengthening treatment; Anomia; Case-report

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Introduction

According to neurocognitive approaches, aphasia is an acquired language disorder that arises following damage to brain regions responsible for language processing, resulting from sudden neurological lesions, and may affect all language modalities, including comprehension, expression, reading, writing, and repetition (1). By definition, aphasia is linguistic in nature; that is, it does not result from cognitive, motor, or sensory deficits, although such disorders may co-occur with it (2). Owing to differences in the site and severity of the neurological lesion, individuals with aphasia constitute a heterogeneous population, each exhibiting varying

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degrees of language impairment; nevertheless, they can be broadly classified into two groups: fluent and non-fluent aphasia (1). The most common cause of aphasia is stroke, particularly ischemic stroke occurring within the territory of the left middle cerebral artery in right-handed individuals (3). It has been reported that 30% of patients with ischemic stroke develop aphasia (4). In Iran, statistics reported in 2012 are consistent with global figures, indicating that 22.7% of stroke patients admitted to hospitals in Tehran develop aphasia (5).

Among all the linguistic deficits observed in individuals with aphasia, naming difficulties, or anomia, are present in all types of aphasia and constitute its most persistent symptom (6). Anomia refers to the inability to select and use appropriate words in verbal output, which may affect connected speech production and, consequently, the individual's participation in communicative interactions (7). Multiple cognitive processes are activated during naming, which can be briefly summarized as semantic retrieval (semantic features), phonological retrieval (the number and arrangement of phonemes), and word production (8, 9). Accordingly, naming errors may result from impairment at either the semantic retrieval or the phonological retrieval stage. These may manifest as semantic paraphasia, phonemic paraphasia, circumlocution, and other error types (10).

The treatment of naming deficits falls within the domain of impairment-based therapeutic approaches (11). The impairment-based approach employs cognitive-linguistic treatments (CLT) to improve language processing across the domains of semantics, phonology, and syntax (12). Given the considerable impact of naming deficits on oral communication, and the fact that naming difficulties are among the most common and persistent impairments in patients with aphasia, arising from deficits in semantic and phonological processing, the cognitive-linguistic approach at the word level constitutes an essential component of aphasia treatment (13). Within the cognitive-linguistic approach, treatment methods aimed at improving naming deficits in patients with aphasia are classified into four categories: semantic, phonological, syntactic, and semantic-phonological treatments, with Verb Network Strengthening Treatment (VNeST) belonging to the semantic category (14, 15).

Research indicates that producing single words in isolation is not, in itself, beneficial, and that producing a single word independently rarely occurs in communication (7, 16). Therefore, the treatment of naming deficits should focus on meaningful communicative functions, the minimum of which is the production of phrases and sentences (16-18). Another important goal of naming treatment, in addition to improving word production and retrieval, is the successful generalization of targeted words to untrained words and everyday conversation (16, 19). From this perspective, most existing treatment methods for naming deficits have been unsuccessful in achieving generalization to untrained items (16, 20). For this reason, verb-based treatments have been developed in recent years to improve lexical retrieval in sentence production (21, 22).

One such approach, which aims to generalize treatment effects to higher linguistic levels and to extend the retrieval of trained words to untrained words, is Verb Network Strengthening Treatment (23). In this treatment method, a hierarchy of language exercises is presented to the patient, including single-word naming of nouns and verbs, and the production of phrases, sentences, and discourse.

The theoretical basis of VNeST rests on the assumption that verbs are semantically central to the sentence and that enhancing verb retrieval facilitates sentence production and, potentially, lexical retrieval during it (18, 24). That is, the systematic activation of the thematic roles of agent (the doer of the action) and patient (the recipient, or the person or thing affected by the action) around target verbs increases the activation of the concepts that constitute verb networks (i.e., content words), thereby increasing the likelihood of accurate retrieval of target words in sentence production (25). For example, the verb "to measure" may activate content words such as "carpenter," "designer," and "wooden board," while the verb "to weigh" is associated with, and activates, "meat," "butcher," "gold," and "cashier" (26). In addition to increasing activation of target concepts, VNeST can also establish semantic distinctions, leading to more successful lexical retrieval (21). Since verbs may carry multiple meanings and be associated differently with various combinations of thematic roles, different scenarios can be derived by expanding the "agent-patient-verb" triad to include where, when, and why the action takes place, thereby facilitating the production of diverse sentences (27).

VNeST is implemented in six steps. First, several scenarios are generated for the target verb based on the questions "Who?" and "What?" In the second step, the client reads the triad (agent-patient-verb) aloud. In the third step, the client selects one of the scenarios generated in the first step and answers three questions about it: "Where?" "When?", and "Why?" In the fourth step, the clinician reads simple sentences containing the target verb, and the participant judges whether each

sentence is semantically correct. In the fifth step, the patient is asked which verb has been practiced. In the final step, the first step is repeated without cues (27).

Several studies have examined VNeST's effectiveness. Edmonds et al. (2009) studied four patients—two with conduction aphasia and two with transcortical motor aphasia—and found generalization to untrained verbs and the sentence level in all four participants. In contrast, generalization to connected speech was observed in three patients (26). Moreover, the treatment effects were maintained for several months after treatment. In the study by Edmonds and Babb (2011), which aimed to examine the effect of VNeST on moderate-to-severe aphasia, both patients demonstrated considerable improvement in trained naming items and in functional communication; however, they did not generalize equally, with one patient showing better generalization (21). Furnas and Edmonds (2013) administered a computerized version of VNeST to two individuals with aphasia. Overall, improvement and generalization were observed in lexical retrieval abilities on confrontation naming of trained and untrained nouns and verbs, and improvements were also observed in sentence and discourse production, as well as in Western Aphasia Battery scores following treatment (28). Edmonds et al. (2014) investigated VNeST in a multiple-baseline design with 11 individuals with moderate aphasia, consisting of a baseline phase, 10 weeks of treatment, post-treatment assessment, and a 3-month follow-up, to further examine and extend the findings of previous studies (29). This study found considerable, significant improvement in trained and untrained sentences, along with a significant increase in more complete utterances and discourse at post-treatment assessment and at the 3-month follow-up in all patients except one (29). Li et al. (2020) administered VNeST in Chinese to two Chinese-English bilingual clients and examined verb retrieval ability in sentences in both languages. Both patients received 10 weeks of online treatment in Chinese, and the treatment effect was assessed in both languages. The results showed that both patients improved after receiving treatment in Chinese and exhibited different patterns of within-language and cross-language generalization (30).

Given VNeST's effectiveness in the aforementioned studies, despite their small sample sizes, the present study aimed to develop a Persian-language VNeST protocol and examine its effect on naming ability in a patient with aphasia.

Materials and Methods

Study Design: This study consisted of two parts. The first part was a psychometric study in which a list of Persian verbs was compiled, and the content validity of the scenarios and the administration procedure was established. In the second part, conducted to evaluate the effectiveness of Verb Network Strengthening Treatment (VNeST) on naming ability, treatment effectiveness was assessed in a patient as a case-report study adopting an ABA design without follow-up.

Participants: In the psychometric phase of the study, 50 cognitively healthy older adults aged 65 years or older from the city of Isfahan who met the inclusion criteria were selected through convenience sampling. In the second part of the study, one individual who met the inclusion criteria was selected through convenience sampling from among patients with aphasia at the clinic of Kashani Hospital. The inclusion criteria for healthy participants in the psychometric study were as follows: age over 65 years; absence of language deficits resulting from receptive or expressive aphasia (determined through interview); absence of hearing and visual impairments not correctable with assistive devices (interview); proficiency in Persian (interview); at least basic literacy in reading and writing Persian (interview); and absence of cognitive impairment (determined through a brief interview) (31). The inclusion criteria for the participant with aphasia were as follows: presence of aphasia (based on the Persian Aphasia Test (32)); at least 9 months post-onset of the lesion (interview) (33); at least basic reading and writing literacy (interview); Persian as the native language and absence of bilingualism (interview); absence of moderate-to-severe oral and verbal apraxia (based on the Oral and Verbal Apraxia Test (34)); absence of signs of severe dysarthria (based on examination by a speech-language pathologist) (35); and presence of a lesion in the left hemisphere with no concurrent lesion in the right hemisphere (based on MRI review by a neurologist). The exclusion criterion for both the healthy participants and the participant with aphasia was unwillingness to cooperate or to continue treatment.

Procedure: Since this study comprised two parts, the procedures for the psychometric study and for the treatment effectiveness study are described separately.

1. Adaptation of VNeST to Persian

In this part of the study, verbs appropriate for this treatment method were first selected, and possible scenarios for each verb were then developed in accordance with the six steps of VNeST. These verbs were required to take two arguments (an agent and a patient), either as transitive with a direct object or as transitive with a complement. To this end, 110 transitive verbs were selected from the 7,000 verbs in

the Valency Dictionary of Persian Verbs (36). An effort was made to select verbs that are frequently used in Persian and for which specific agents and patients—necessary for activating the neural network targeted by VNeST—could be readily extracted in practice. All of these verbs were reviewed by a panel of experts consisting of one consulting linguist, three speech-language pathologists familiar with VNeST, and two speech-language pathologists from the research team. The experts reviewed the verbs both in person and online, and several verbs for which sufficient specific agents and patients could not be generated were eliminated. Following verb selection, all possible scenarios, together with their agents, patients, and the corresponding cues, were developed for each verb. Although the VNeST protocol states that attention to morphological and grammatical aspects in the production of verbs and sentences is not required (27), given the complex morphological and grammatical rules of Persian, all verbs were selected in the third-person singular simple past form, and, following scenario development, verb conjugation and tense were reviewed by the expert panel where necessary.

Two sources were used to establish content validity: the expert panel and healthy individuals. All scenarios were presented to the expert panel for review and feedback over five consecutive sessions. The panel's feedback was received and incorporated into the scenarios during the same session, and the revisions were read aloud to the members once more in the following panel session. Finally, all scenarios were sent to the expert panel and their final approval was obtained.

Subsequently, 50% of the scenarios were randomly selected using a random number table and presented to the 50 healthy older adults, who were asked the following questions: "When you read the scenarios and sentences, do you understand all of them?", "In your opinion, are the agents and patients selected for the verb appropriate?", and "Can you think of any other agent or patient that should be added?"

Finally, after the selection of the verbs, scenarios, and corresponding cues, in order to establish the content validity of the VNeST administration procedure, the written VNeST manual was provided (individually) to the members of the research expert panel and to five speech-language pathologists outside the research team, and their opinions were surveyed. The survey questions included "Is each of the six prepared steps comprehensible and feasible for you to administer?" and "Are all of the steps consistent with the Persian language?"

2. Administration of VNeST to a Patient with Aphasia

Initially, based on records of clients with aphasia referred to the Speech Therapy Department at Kashani Hospital in Isfahan, a patient who met the inclusion criteria was selected. After the study and its stages were explained to the patient and his family, the informed consent form was signed by the patient and his family. This part of the study was conducted as a case report adopting an ABA single-case design without a follow-up phase. Based on previous studies, VNeST improves confrontation naming ability in patients with aphasia; therefore, a naming test was used to establish the baseline phase and to conduct assessments in subsequent phases (37). The first baseline (A1) was determined from scores obtained on the Persian Naming Test across four sessions, held twice per week. In the treatment phase (B), VNeST was administered for 10 weeks, with two treatment sessions and one assessment session each week using the Persian Naming Test. Treatment sessions lasted one hour; although the English-language VNeST protocol recommends 1.5 to 2 hours per session, the participant in the present study could not sustain sessions longer than one hour. One verb, together with its associated materials, was trained each week. The verbs used were: to drive, to eat, to read, to measure, to sweep, to turn on, to clean, to repair, to serve (guests), and to fine. The second baseline (A2) assessments were conducted immediately after treatment completion and over two weeks, with two sessions per week. The Persian Naming Test was used in the post-treatment assessment to establish the A2 baseline. We used lexical richness and speech quality as measures of treatment outcome and to calculate the effect size in this case. Lexical richness before and after treatment was determined by the number of unique content words produced in narrating the "Bird" story, which is part of the Persian Western Aphasia Battery (P-WAB) (32).

Data Analysis: In the first part of the study, data were analyzed qualitatively. In the second part, we employed visual analysis methods, including calculating the mean, median, range, and stability envelope of the data; the absolute level, trend, and the percentage of non-overlapping data (PND) (38).

Results

Since this study consisted of two parts, the findings of the psychometric and treatment effectiveness studies are reported separately.

1. Verb Selection and Content Validity of the Scenarios and Administration Procedure

Verb selection: Ultimately, the expert panel approved 102 verbs. All selected verbs were either transitive with a direct object or transitive with a complement (e.g., *pushidan*, "to wear"). The final 102 selected verbs are presented in Table 1.

Table 1. Final verbs selected for use in the protocol

No.	Verb	Object/Complement	No.	Verb	Object/Complement	No.	Verb	Object/Complement
1	to drive/steer	Object	35	to repair	Object	69	to boil	Object
2	to drive a vehicle	Object	36	to shorten/trim	Object	70	to cheat	Complement
3	to plant	Object	37	to perform	Object	71	to dig/pluck	Object
4	to buy	Object	38	to sweep	Object	72	to mop	Object
5	to sell	Object	39	to paint/dye	Object	73	to clean	Object
6	to cut	Object	40	to turn off	Object	74	to tidy	Object
7	to teach	Object and complement	41	to turn on	Object	75	to play an instrument	Object
8	to give lessons	Object and complement	42	to take a photograph	Complement	76	to evaluate	Object
9	to teach	Object and complement	43	to learn	Complement	77	to give an exam	Complement
10	to instruct	Object and complement	44	to draw	Object	78	to counsel/provide psychotherapy/psychoanalyze	Object and complement
11	to teach formally	Object and complement	45	to propose marriage	Complement	79	to warn/remind	Complement
12	to deliver/take someone	Object	46	to marry	Complement	80	to hand over	Complement
13	to build/make	Object	47	to save/store	Object	81	to price	Complement
14	to read	Complement	48	to fine	Object	82	to listen	Complement
15	to study	Object	49	to treat/cure	Object	83	to watch	Object
16	to make laugh	Object	50	to examine medically	Object	84	to discover	Object
17	to hear	Object	51	to suture	Object	85	to test	Object
18	to win	Object	52	to dress a wound	Object	86	to bring	Object
19	to lose	Object	53	to operate on	Object	87	to collide with	Complement
20	to pull/draw	Object	54	to inject	Object	88	to put on sale	Object
21	to eat	Object	55	to take care of	Complement	89	to raise/breed	Object
22	to shave/carve	Object	56	to give a check-up	Object	90	to coach/train	Complement
23	to knit	Object	57	to apply makeup	Object	91	to wash	Object
24	to sharpen	Object	58	to threaten	Object	92	to report	Complement
25	to cook	Object	59	to serve/host	Complement	93	to judge/referee	Object
26	to hit	Object	60	to irrigate/water	Object	94	to climb	Complement
27	to sew	Object	61	to play	Complement	95	to search	Object
28	to write	Object	62	to film	Complement	96	to hire	Object
29	to send	Object	63	to see a patient	Object	97	to extract	Object
30	to wear	Object	64	to measure	Object	98	to produce	Object
31	to fear	Object	65	to drop off	Object	99	to relieve/soothe	Object
32	to frighten	Object	66	to advertise	Object	100	to repair a puncture	Object
33	to dance	Complement	67	to weave/braid	Object	101	to research	Object
34	to stick/glue	Object	68	to cut off	Object	102	to construct	Object

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Content validity of the scenarios for the verbs: All agents, patients, scenarios, and cues were judged appropriate by the 50 healthy participants. Based on the feedback collected, no changes were made to the scenarios. The healthy participants thus confirmed content validity.

Content validity of the protocol: Based on the reviews conducted, the protocol's steps were appropriate in content and feasible for clinicians to administer, and the content validity of the administration procedure was confirmed by the expert panel and five speech-language pathologists.

2. Effectiveness of the Developed VNeST Protocol on Improving Naming Ability

Participant characteristics: The participant was a 42-year-old man with aphasia resulting from a stroke in the anterior perisylvian region. At the time of the study, 16 months had elapsed since the event. Based on the assessments conducted and the patient's own complaint, his primary language deficit was impaired naming. The patient was right-handed and held a master's degree. His score on the Mini-Mental State Examination was 30, indicating no cognitive impairment. His scores on the oral apraxia and verbal apraxia tests were 3 and 15, respectively, indicating the absence of oral apraxia and the presence of mild apraxia of speech. The bedside version of the Persian Western Aphasia Battery was used to determine the patient's language status (32). Table 2 presents the patient's scores on the six subtests of this battery, along with the calculated Aphasia Quotient (AQ).

Table 2. Patient's scores on the bedside version of the Persian Western Aphasia Battery

Subtest	Patient's score
Speech content	5
Speech fluency	6
Auditory comprehension of yes/no questions	10
Comprehension of commands	7
Repetition	5.75
Naming	5.5
Aphasia Quotient	66.25

Based on the obtained AQ, the patient's aphasia was classified as moderate (32). The patient's lexical richness index prior to treatment was also calculated based on the "Bird" story, yielding a value of 46%.

Results of naming assessment before and after treatment: Table 3 and Figure 1 present the patient's raw scores on the naming test across the three phases: first baseline, treatment, and second baseline.

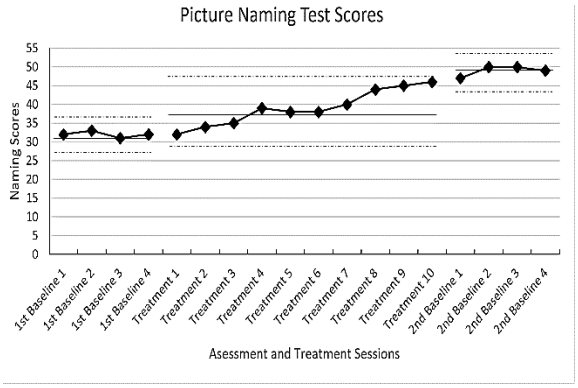


Figure 1. Patient's confrontation naming scores across the three study phases

As shown in Table 3 and Figure 1, during the first baseline phase, the patient's naming scores across four consecutive sessions fluctuated between 31 and 33 (mean = 32), indicating stable performance prior to the onset of the intervention. With the initiation of treatment, the score in the first session (32) was equal to the final baseline score and increased slightly over the following two sessions (scores of 34 and 35); however, from the fourth treatment session onward, a clear upward trend emerged, with scores rising progressively from 39 to 46. The mean score in the treatment phase was 39.1 (range: 32–46), and the final score in this phase was 14 points higher than the initial score.

In the second baseline phase, following the withdrawal of treatment, scores not only did not return to the level of the first baseline but reached the highest level of the entire study, with a range of 47 to 50 (mean = 49.0). The difference between the means of the first and second baselines was 17 points (an increase of approximately 53% relative to the initial level), indicating the magnitude and stability of the change achieved. Moreover, the lowest score in the second baseline (47) exceeded the highest score in the treatment phase (46); thus, no overlap was observed among the three phases of the study.

Results of within-phase data analysis: Table 4 presents the number of data points, mean, median, stability envelope, level stability, absolute level, and its interpretation for each phase.

Table 3. Patient's confrontation naming scores across the three study phases

Session	1	2	3	4	5	6	7	8	9	10
First baseline (A1)	32	33	31	32	–	–	–	–	–	–
Treatment (B)	32	34	35	39	38	38	40	44	45	46
Second baseline (A2)	47	50	50	49	–	–	–	–	–	–

Table 4. Characteristics of each phase and determination of level stability and absolute level

Phases	A1	B	A2
Phase length (number of data points)	4	10	4
Median	32	38.5	49.5
Mean	32	39.1	49
Stability envelope	25.6-38.4	32.7-45.5	42.6-55.4
Level stability	100%	80%	100%
First data point	32	32	47
Last data point	32	46	49
Absolute level	0	14	2
Interpretation of absolute level	Stability of naming deficits	Improvement in naming	Improvement in naming

As shown in Table 4, the patient demonstrated stable performance across all phases of the study. Although variability increased slightly in phase B with the introduction of the intervention, the 80% criterion nonetheless indicates data stability. In effect, with treatment, the patient's correct responses on the naming test increased but did not vary substantially over the course of the phase. At the absolute level, the treatment improved naming performance on the naming test used in this study. Furthermore, following the withdrawal of treatment, naming scores continued to rise.

Results of the between-phase analysis: According to Figure 1 and Table 3, 9 data points exceed the highest baseline value (score of 33), out of a total of 10 treatment data points. The PND is therefore 90%, indicating a strong effect of VNeST on naming in this patient.

Treatment outcome: The patient narrated the "Bird" story once before and once after treatment. Based on these narrations, the number of nouns used increased from 10 to 14, the number of verbs from 13 to 20, and the number of word types from 23 to 34; the patient's lexical richness percentage and speech quality also improved after treatment. Therefore, based on the data obtained from the analysis of the number and type of words used in speech, it can be concluded that the patient's fluency increased following treatment (Table 5).

Discussion

The present study was conducted with two objectives: first, to adapt the Verb Network Strengthening Treatment (VNeST) protocol to Persian and to establish the content validity of its verbs, scenarios, and administration procedure; and second, to conduct a preliminary investigation of the effectiveness of this protocol on the naming ability of a Persian-speaking patient with aphasia within an ABA single-case design. The findings indicated that the Persian version of the protocol possesses satisfactory content validity, and that its administration was accompanied by a considerable and stable improvement in confrontation naming, as well as an increase in the lexical richness of the patient's connected speech. Given the study's two-part structure, the results of each part are discussed below in turn.

1. Adaptation of the Protocol to Persian

In the first part of the study, 102 verbs that were transitive with a direct object or a complement were selected from the Valency Dictionary of Persian Verbs (36) following review by the expert panel. The principal selection criterion was the possibility of extracting multiple, specific agents and patients for each verb—a criterion consistent with the theoretical basis of VNeST, since in this method the activation of the semantic network around a verb occurs only when the verb can be combined with diverse configurations of thematic roles (27). The approval of the scenarios by 50 healthy older adults without any need for revision indicates that the selected agents and patients are congruent with the linguistic knowledge and cultural experience of Persian speakers; this is of particular importance in the cross-cultural adaptation of therapeutic tools, since the scenarios of the English version are not necessarily familiar or applicable to the Iranian cultural context.

2. Effectiveness of the Treatment on Naming

In the second part, the patient's naming scores increased from a mean of 32 at the first baseline to 49 at the second baseline. The complete stability of the first baseline (range 31–33) across four sessions, together with the 16 months that had elapsed since the stroke, largely rules out the possibility of spontaneous recovery or practice effects arising from repeated testing, and allows the changes observed in the treatment phase to be attributed to the intervention with greater confidence.

Table 5. Calculation of speech quality and lexical richness before and after treatment

Date	Total words	Function words	Content words	Nouns	Verbs	Word types	Lexical richness index (type/token)
24 May 2023 (3/3/1402)	60	10	50	10	13	23	46%
23 September 2023 (1/7/1402)	76	16	60	14	20	34	56%

The PND value of 90%, according to the conventional criteria for interpreting this index, falls within the range of a "highly effective treatment" (39), and the absolute change of 14 points during the treatment phase reflects the magnitude of this effect.

The temporal pattern of change is noteworthy. During the first three treatment sessions, naming scores changed only slightly (32, 34, 35), and improvement accelerated from the fourth week onward. This pattern aligns with Edmonds et al. (2011) (21), who described the effects of VNeST as gradual and dependent on the accumulation of practice on semantic networks, rather than an immediate response to training on specific items. From this perspective, the initial delay may be regarded as evidence of the network-based and non-item-specific nature of the treatment effect.

The most important finding of this part is the generalized nature of the improvement. Over the ten weeks of treatment, only ten verbs were trained, whereas the outcome measure was the standardized Persian Naming Test, none of whose items had been practiced during treatment. The 17-point improvement therefore reflects generalization to untrained vocabulary rather than the learning of specific items. This finding is consistent with the fundamental assumption of VNeST that activation of the "agent–verb–patient" network also leads to the retrieval of content words outside the training set (21), and accords with the results of Edmonds et al. (26) and Edmonds (2016) (23), who reported generalization to untrained nouns and verbs. Given that failure to generalize is the principal weakness of most naming treatments (20), this finding is of particular clinical significance.

The increase in lexical richness in the retelling of the "Bird" story (from 46% to 56%), along with increases in the numbers of nouns, verbs, and word types, provides evidence of generalization at the discourse level. This result is consistent with that of Edmonds et al. (29), who found increased completeness of connected speech following VNeST. However, in the present study, it should be interpreted with caution owing to the single pre- and post-treatment measurement.

The upward trend in scores in the second baseline (47 to 50) is also worth attention. The continued increase following treatment withdrawal may indicate ongoing consolidation of semantic networks after the end of the intervention, a phenomenon also reported in follow-up assessments in previous VNeST studies (29). However, since, in an ABA design, the behavior is expected to return to baseline upon withdrawal of the intervention, this pattern suggests that the changes achieved represent durable learning and that the ABA design does not necessarily provide complete experimental control for interventions with lasting effects.

The patient in the present study was a 42-year-old man with moderate aphasia, an anterior perisylvian lesion, and mild apraxia of speech—characteristics that correspond to the profile of participants in previous VNeST studies (predominantly non-fluent aphasia of moderate severity) (21). The patient's high level of education and intact cognitive status may have contributed to his favorable response to this treatment, which requires active scenario generation and semantic judgment. Moreover, the reduction of session length to one hour (as opposed to 1.5 to 2 hours in the original protocol) owing to the patient's fatigability indicates that a considerable therapeutic effect can be obtained even at a lower dose; this point has practical importance for application in Iranian clinical settings and merits systematic investigation in dose–response studies.

Limitations

This study has several limitations that should be taken into account in interpreting the findings. First, administering the treatment to only one patient limits the generalizability of the results, and the findings should be regarded as preliminary evidence. Second, the absence of a follow-up phase precludes any judgment regarding the maintenance of treatment effects. In contrast, previous studies have reported the retention of gains for up to three months (27). Third, the ABA design offers weaker experimental control than multiple-baseline designs across behaviors or across participants. Fourth, effectiveness was measured solely on confrontation naming, and sentence production, the direct target of VNeST, was not assessed independently. Fifth, the analysis of connected speech was based on a single speech sample collected before and after treatment, and inter-rater reliability was not reported. Finally, content validity was established qualitatively, and quantitative indices such as the CVR and CVI were not calculated.

Recommendations

It is recommended that future studies implement the Persian VNeST protocol in multiple-baseline designs with several patients presenting with different types and severities of aphasia, incorporating a follow-up phase and measures of sentence and discourse production. Comparing the effectiveness of simple and compound verbs and determining the optimal treatment dose in Persian-speaking patients are important topics for subsequent research. Researchers should also consider administering VNeST to bilingual

individuals with aphasia and examining its effectiveness in the second language.

Conclusion

The present study demonstrated that, with appropriate adaptation of verbs, scenarios, and morphological features, VNeST can be implemented in Persian and that its administration procedure has content validity. The preliminary clinical findings also indicate the effectiveness of this protocol in improving naming and its generalization to untrained vocabulary and connected speech in a Persian-speaking patient with aphasia. These results present the Persian version of VNeST as a promising option for treating anomia in Persian-speaking patients, the validity of which should be confirmed in larger-scale studies.

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Maintaining the integrity of the study process from the beginning to the publication, and responding to the reviewers' comments: Marzieh Ayoubi, Amin Modarres Zadeh, Leila Ghasisin

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Conflict of Interest

The authors did not have a conflict of interest.

References

1. Papathanasiou I, Coppens P, Potagas C. Aphasia and related neurogenic communication disorders: Jones & Bartlett Publishers; 2013.
2. Hegde MN. A coursebook on aphasia and other neurogenic language disorders. 2022.
3. Grönberg A, Henriksson I, Stenman M ,Lindgren AG. Incidence of Aphasia in Ischemic Stroke. Neuroepidemiology. 2022; 56(3): 174-82.
4. Coppens P. Aphasia and related neurogenic communication disorders: Jones & Bartlett Publishers; 2016.
5. Soltani S, Khatoonabadi AR, Jenabi MS, Piran A. Frequency of aphasia resulting from stroke at hospitals affiliated to Tehran University of Medical Sciences. Modern Rehabilitation. 2013; 6(4).
6. Laine M, Martin N. Anomia: Theoretical and clinical aspects: Psychology Press; 2006.
7. Benson DF. Anomia in aphasia. Aphasiology. 1988; 2(3-4): 229-35.
8. Levelt WJ, Roelofs A, Meyer AS. A theory of lexical access in speech production. Psycholinguistics: critical concepts in psychology. 2002: 278-377.
9. Goodglass H, Wingfield A. Anomia: Neuroanatomical and cognitive correlates: Academic Press; 1997.
10. Dell GS, Schwartz MF, Martin N, Saffran EM, Gagnon DA. Lexical access in aphasic and nonaphasic speakers. Psychological Review. 1997; 104(4): 801-38.
11. Hillis AE. The Handbook of Adult Language Disorders: Taylor & Francis; 2015.
12. Jong-Hagelstein M. Word finding deficitsin aphasia: diagnosis and treatment. Rotterdam Aphasia Therapy Study-2 [PhD thesis]. 2011.
13. de Jong-Hagelstein M, Van de Sandt-Koenderman W, Prins N, Dippel D, Koudstaal P, Visch-Brink E. Efficacy of early cognitive–linguistic treatment and communicative treatment in aphasia after stroke: a randomised controlled trial (RATS-2). Journal of Neurology, Neurosurgery & Psychiatry. 2011; 82(4): 399-404.
14. Nickels L. Therapy for naming disorders: Revisiting, revising, and reviewing. Aphasiology. 2002; 16(10-11): 935-79.
15. Thompson CK, Shapiro LP, Kiran S, Sobecks J. The role of syntactic complexity in treatment of sentence deficits in agrammatic

aphasia: the complexity account of treatment efficacy (CATE) .J Speech Lang Hear Res. 2003; 46(3): 591-607.
16. Wisenburn B, Mahoney K. A meta-analysis of word-finding treatments for aphasia. Aphasiology. 2009; 23(11): 1338-52.
17. Doedens WJ, Meteyard L. What is Functional Communication? A Theoretical Framework for Real-World Communication Applied to Aphasia Rehabilitation. Neuropsychol Rev. 2022; 32(4): 937-73.
18. Webster J, Whitworth A. Treating verbs in aphasia: exploring the impact of therapy at the single word and sentence levels. Int J Lang Commun Disord. 2012; 47(6): 619-36.
19. Carragher M, Conroy P, Sage K, Wilkinson R. Can impairment-focused therapy change the everyday conversations of people with aphasia? A review of the literature and future directions. Aphasiology. 2012; 26(7): 895-916.
20. Webster J, Whitworth A, Morris J. Is it time to stop "fishing"? A review of generalisation following aphasia intervention. Aphasiology. 2015; 29(11): 1240-64.
21. Edmonds LA, Babb M. Effect of verb network strengthening treatment in moderate-to-severe aphasia. 2011.
22. de Aguiar V, Bastiaanse R, Miceli G. Improving Production of Treated and Untreated Verbs in Aphasia: A Meta-Analysis. Front Hum Neurosci. 2016; 10: 468.
23. Edmonds LA. A review of Verb Network Strengthening Treatment: Theory, methods, results, and clinical implications. Topics in Language Disorders. 2016;36(2):123-35.
24. Thompson CK, Lange KL, Schneider SL, Shapiro LP. Agrammatic and non-brain-damaged subjects' verb and verb argument structure production. Aphasiology. 1997; 11(4-5): 473-90.
25. Ferretti TR, McRae K, Hatherell A. Integrating Verbs, Situation Schemas, and Thematic Role Concepts. Journal of Memory and Language. 2001; 44(4): 516-47.
26. Edmonds LA, Nadeau SE, Kiran S. Effect of Verb Network Strengthening Treatment (VNeST) on lexical retrieval of content words in sentences in persons with aphasia. Aphasiology. 2009; 23(3): 402-24.
27. Edmonds LA. Tutorial for Verb Network Strengthening Treatment (VNeST): Detailed description of the treatment protocol with corresponding theoretical rationale. Perspectives on Neurophysiology and Neurogenic Speech and Language Disorders. 2014; 24(3): 78-88.
28. Furnas DW, Edmonds LA. The effect of computerised Verb Network Strengthening Treatment on lexical retrieval in aphasia. Aphasiology. 2014; 28(4): 401-20.
29. Edmonds LA ,Mammino K, Ojeda J. Effect of Verb Network Strengthening Treatment (VNeST) in persons with aphasia: extension and replication of previous findings. Am J Speech Lang Pathol. 2014; 23(2): S312-29.
30. Li R, Li W, Kiran S. Effect of Mandarin Verb Network Strengthening Treatment (VNeST) in Mandarin-English bilinguals with aphasia: A single-case experimental design. Neuropsychological Rehabilitation. 2021; 31(8): 1224-53.
31. Martin PK, Surineni K, Schroeder RW. Diagnostic Interviewing and Cognitive Screening. In: Hilsabeck RC, Ayers GY, Hilsabeck RC, Ayers GY, Hilsabeck RC, Ayers GY, editors. Dementia: Oxford University Press; 2024.
32. Nilipour R, Shahbaz A, Ghoreishi Z, Yousefi A. Reliability and Validity of Persian Aphasia Battery Test. Iranian Journal of Ageing. 2016; 10: 182-90.
33. Wilson SM, Entrup JL, Schneck SM, Onuscheck CF, Levy DF, Rahman M, et al. Recovery from aphasia in the first year after stroke. Brain. 2023; 146(3): 1021-39.
34. Yadegari F. Oral and verbal apraxia tasks for adults. Tehran, Iran: University of Social Welfare and Rehabilitation Sciences. 2014: 47.
35. Altaher AM, Chu SY, Razak RA. A report of assessment tools for individuals with dysarthria. The Open Public Health Journal. 2019; 12(1).
36. Rasooli MS, Moloodi A, Kouhestani M, Minaei-Bidgoli B, editors. A syntactic valency lexicon for Persian verbs: The first steps towards Persian dependency treebank. 5th Language & Technology Conference (LTC): Human Language Technologies as a Challenge for Computer Science and Linguistics; 2011.
37. Nilipour R PA, Ghoreishi Z S. Measure of Reliability and Validity of Persian Picture Naming Battery. Speech and Language Pathology. 2014: 18-25.
38. Kratochwill TR, Hitchcock JH, Horner RH, Levin JR, Odom SL, Rindskopf DM, et al. Single-case intervention research design standards. Remedial and Special Education. 2013; 34(1): 26-38.
39. Scruggs TE, Mastropieri MA. Summarizing single-subject research. Issues and applications. Behav Modif. 1998; 22(3): 221-42.